THE NORTH-AMERICAN REVIEW.

Memoirs of the American Academy of Arts and Sciences, Vol. 3d. Part 2d. pp. 333, Cambridge, Hilliard and Metcalf.

We see with great pleasure that this most respectable society is steadily pursuing its course, and we may add *vires acquirit eundo.* The present publication, which is the second part of the third volume, is the most valuable of their transactions. It contains, among other papers, several very interesting and important astronomical and mathematical articles, and a memoir on the present state of the English language in the United States, which would be sufficient in itself, to give a value to the volume. It is to be regretted, that there are so few chemical or mineralogical communications; the very complete analysis of the sulphate of Barytes from Hatfield, shews that this is not from want of skill. The field of mineralogy in our country is so rich and extensive, and has been so imperfectly explored, that the society would render great service by collecting accurate investigations on this branch of science. The papers of professors Farrar, Cleveland, and Dean, prove, that we are possessed of able astronomical observers, and men who feel that ardour in the cause of science, which is so honourable to a country, while we may congratulate this society and the publick, that they possess in Mr. Bowditch a man, who, to the greatest modesty and simplicity of manners, joins such profound acquisitions in mathematicks and astronomy, as must place him in the very first class of scientifick men at the present day. We shall endeavour to give some account of this volume, though many of the papers, are of a description, that cannot be abbreviated or made intelligible by an abstract.

No. XXXII. An estimate of the height, direction, velocity and magnitude of the meteor, that exploded over Weston in Connecticut, December 14th, 1807. With methods of calculating observations made on such bodies. By Nathaniel Bowditch, A.M. A.A.S. &c.

The object of this paper is fully stated by the author in the following words. 'The extraordinary meteor which appeared at Weston in Connecticut, on the fourteenth of 'December, 1807, and exploded with several discharges, 'having excited great attention throughout the United 'States, and being one of those phenomena of which, few 'exact observations are to be found in the history of physical science, I have thought that a collection of the best 'observations of its appearance at different places, with the 'necessary deductions for determining, as accurately as possible, the height, velocity, direction and magnitude of the 'body, would not be unacceptable to the Academy, since 'facts of this kind, besides being objects of great curiosity, 'may be useful in the investigation of the origin and 'nature of these meteors; and as the methods of making 'these calculations, are not fully explained in any treatise 'of trigonometry, common in this country, I have given 'the solutions of two of the most necessary problems, with 'examples calculated at full length.'

In the first of these problems, the situation of the meteor is determined by means of its azimuths, observed in two given places at the same moment of time, and its angular elevation above the horizon of one of those places. In the second problem, the situation is obtained by means of one azimuth, and the angular elevation observed at both places, by a theorem which appears to be new, as it is not noticed in any treatise of sphericks we have seen. These solutions are applied to the observations made at Wenham, in the Latitude of 42° 40′ 15″ North, and Longitude of 70° 50′ 15″ West from Greenwich; at Weston, in the Latitude of 41° 15′ North, and Longitude 73° 27′ West; and at Rutland in the Latitude of 43° 36′ North, and Longitude of 72° 58′ 15″ West.

From the observations made at those places, the author shows, by various calculations, that the course of the meteor '*was about S. 7° W. in a direction nearly parallel to the surface of the earth, and at the height of eighteen miles*'—it passed over a space of more than 107 miles while visible at Rutland and Weston, and this time was by estimation about thirty seconds, therefore the *velocity of the meteor probably exceeded three miles per second*, which is fourteen times as swift as the motion of sound, and nearly

as great, as the velocity of a satellite, revolving about the earth at the same distance.

At the time of the first appearance of the meteor at Weston, it was 113 miles distant from that place, nearly in a north direction ; it was then but little elevated above the horizon ; at the time of explosion, near the zenith of Weston, it was only 20 miles distant from the observer ; at the same moment it could have been seen at Wenham, at the distance of 167 miles, and this is the greatest distance at which it was seen.

Some of the observers supposed the meteor to have appeared as large as the moon when full, others estimated it at one half, or one quarter of that magnitude. The real diameter of the meteor resulting from the greatest of these estimates would exceed a mile. 'The least of all the 'limits of that diameter is 491 feet. A body of this last 'magnitude, and of the same specifick gravity as the stone 'that fell at Weston (which weighed about 225 pounds to 'a cubick foot) would contain a quantity of matter exceeding in weight *six millions of tons.* If the specifick gravity were the same as that of the air at the surface of the 'earth, the quantity of matter would exceed *two thousand* '*tons,* and if the specifick gravity were the same as that of 'the air at the height of the meteor, the quantity of matter 'would exceed *fifty tons.* Either of these estimates exceeds by far the weight of the whole mass that fell near 'Weston, which, by the accounts published, does not appear 'to have been greater than half a ton, and would not form a 'sphere of two feet diameter of the same specifick gravity as 'the stone, as was observed by Professor Day, in his valuable paper on the origin of meteorick stones. A sphere of 'this diameter, seen at the distance of the meteor from 'Wenham, would hardly be visible without the assistance of 'a telescope, since its apparent diameter would not exceed 'two thirds of a second. These facts seem to favour the 'opinion, that part of the mass continued on its course without falling to the earth near Weston, and the gradual disappearance of the meteor, observed by Judge Whealer, 'is agreeable to this hypothesis.'

'As it is but within a few years, that observations of these 'meteors have been carefully made, we have not yet sufficient data for a well-grounded theory of their nature and 'origin : none that has yet been proposed is free from

'difficulties. The greatness of the mass of the Weston 'meteor does not accord, either with the supposition of its 'having been formed in our atmosphere, or projected from 'a volcano of the earth or moon; and the striking unifor- 'mity of all the masses that have fallen at different places 'and times (which indicates a common origin) does not, if 'we reason from the anology of the planetary system, 'altogether agree with the supposition, that such bodies are 'satellites of the earth.'

No. XXXIII. This paper communicated by Dr. Gorham, gives an account of a very complete analysis of sulphate of Barytes, found at Hatfield and Northampton, in Massachusetts. The results make the component parts of the mineral as follows: Barytes 58.50. Sulphurick acid 29.33. Sile 4. Alumina 2. Water 3. Loss 2.67.

No. XXXIV. *Investigation of the apparent motion of the Earth viewed from the Moon, arising from the Moon's librations. By James Dean, A. M. Professor of Mathematicks, &c.*

The following extract will shew the object of this paper.

'If the moon moved uniformly about the earth in the 'ecliptick, with an angular motion exactly equal to that of 'the moon's diurnal rotation, and in the same direction, and 'the lunar equator coincided with the ecliptick, the earth, 'viewed from any part of the moon's surface, would 'always appear in the same situation above the horizon of 'the spectator, or with the same azimuth and altitude. To 'a spectator placed on the centre of the moon's disc the 'earth would constantly appear in the zenith; to one situ- 'ated on the borders of the disc it would appear in a par- 'ticular point of the horizon, and in other points of the disc 'it would appear at a fixed altitude and azimuth, corres- 'ponding to the place of the observer. The inequality of 'the moon's motion about the earth, combined with 'the effect of the lunar orbit and equator (which cause 'the moon's librations) produce to a spectator, placed on the 'surface of the moon, an apparent motion of the earth 'about its mean place, supposed at rest; to investigate 'which is the object of the present memoir.'

In this investigation, only the two greatest of the inequalities of the motion are noticed, that arising from the chief

term of the elliptical motion of the moon in her orbit, which is about 6° 18′, and that arising from the inclination of the lunar orbit to the ecliptick, which is about 6° 39′. By the former, the earth, viewed from the moon, would appear to the east or west of its mean place; and, by the latter, it would appear to the north or south of the mean place. These two inequalities produce a wonderful variety, in the apparent curves described by the earth about its mean place. For when the moon's apogee, and the ascending node of the lunar orbit, are in conjunction, this apparent motion in each lunation appears to be made nearly in a straight line, or rather in an arch of a great circle of the heavens, 18 degrees in length. As the apogee advances and the nodes recede, this line opens into an oval, and when the apogee is 90° forward of the ascending node, the apparent motion will be in an oval curve 12° 36′ broad, from east to west, and 13° 18′ long, from north to south, which will be described *according to the order of the signs* in each lunation. As the line of apsides advances in the orbit, this oval contracts in width, and finally becomes a right line, or rather a great circle, 13 degrees in length (nearly at right angles to the former line or great circle) which is then described in every lunation. This great circle again becomes of an oval form as the apogee advances farther in the orbit, and when the apogee is 270° from the moon's ascending node, it again becomes an oval 12° 36′ broad from east to west, and 13° 18′ long from north to south; but the motion in this case will be *contrary to the order of the signs*, or opposite to its former motion. As the apogee advances, this oval contracts and it finally becomes a straight line, or a great circle, when the apogee and ascending node again coincide, and then all these motions will recommence in the same order. The period of this cycle of motions is but little short of six years.

The author shows how these motions may be imitated by a pendulum suspended from two points, on which subject we shall hereafter have occasion to speak in our review of the 52d article of this volume.

Nos. XXXV, XXXVI, XXXVII, XXXVIII, contain observations of the Solar Eclipse of Sept. 17, 1811, made at Portland, by the Rev. I. Nichols; at Bowdoin College,

Brunswick, by Professor Cleveland; at Burlington College, by Professor Dean and J. Johnson, Esq.; and at Nantucket by Walter Folger, jr. Esq.

No. XXXIX. *On the Eclipse of the Sun of Sept.* 17, 1811, *with the longitudes of several places in this country, deduced from all the observations of the Eclipses of the Sun and Transits of Mercury and Venus, that have been published in the Transactions of the Royal Societies of Paris and London, the Philosophical Society held at Philadelphia, and the American Academy of Arts and Sciences. By Nathaniel Bowditch, A. A. S. &c.*

In addition to the observations of the eclipse of Sept. 17, 1811, mentioned in the preceding papers, we have here those made at Salem, Monticello, Washington, Williamsburg, New-Brunswick, New-Haven, Rutland, and New-York. These observations are more important, as the eclipse was not observed in Europe, and the observations are useful in determining the errours of the Lunar Tables. According to Mr. Bowditch's calculation from these observations, the ecliptick conjunction of the sun and moon was at 6^h 57′ 6″,1, apparent time at Greenwich, at which time the sun's longitude, by De Lambre's tables, (Vince's edition) was 173° 56′ 32″,4, the moon's longitude by Burg's Tables (same edition) was 173° 56′ 44″,4, their difference 12″,0, represents the errour of the lunar tables in longitude, supposing the sun's longitude to be correct. At the same time the moon's latitude by Burg's, Tables, was 56′ 50″,8 N. by observations of this eclipse 36′ 40″,2, errour of the tables—10″,6. In reducing these observations to Greenwich, the longitude of Harvard-Hall, in our University of Cambridge was used, estimating it at 4^h 44′ 29″,7, west from the Royal observatory at Greenwich, as found by Mr. Bowditch from the mean of several observations of Solar Eclipses and Transits, made at Cambridge and its vicinity, the longitude of this place he supposes to be '*more accurately ascertained than that of 'any other place in the United States.*'

Having computed the longitudes of the places where the eclipse of Sept. 17, 1811, was observed, Mr. Bowditch then calculates the longitudes of those places in America, where the Solar Eclipses of Aug. 5, 1766; June 24, 1778; Oct. 27, 1780; April 3, 1791; June 26, 1805, and June 16, 1806, were observed; also those where the Transit of Venus of June 3, 1769, and those of Mercury of Nov. 5,

1743; Nov. 9, 1769; Nov. 12, 1782, and Nov. 9, 1789, were observed.

At the end of this paper is given an explanation and demonstration of the method of computing the altitude and longitude of the Nonagexinal degree of the ecliptick, published in the third edition of Mr. Bowditch's 'Practical 'Navigator.' This method is peculiarly adapted to the case where more than one of the phases of the eclipse are to be calculated, or where the operation is to be repeated to obtain a more accurate result.

No. XL, contains observations of the eclipse of the sun of September 17, 1811, of the variation of the magnetical needle, and several meridian altitudes of the sun, moon, and stars, at Deerfield, Massachusetts, by Epaphras Hoyt.

No. XLI, by Professor Farrar, contains a general description of the comet of 1811, and a regular series of observations from September 6th to January 8th. During this time, according to Professor Farrar, 'it described an arch of 132°, as seen from the earth. The apparent motion at first was about one degree per day; its velocity increased, till it amounted to a little more than one degree and three fourths per day, and then began to decrease, and continued to decrease till it disappeared; when its daily motion, as referred to the earth, was only about twenty minutes. It came within the circle of perpetual apparition about the 20th of September, and continued within it twenty days. It reached its greatest apparent northern declination, which was fifty degrees, about the 2d of October, and its greatest northern latitude, sixty-three and a half degrees, about the 17th of the same month. When it was first seen on the 6th of September its longitude was about eighteen degrees less than that of the sun. After continuing for some time at about the same distance, it gained upon the sun, and the 11th of September came up with it, and passing it arrived at its greatest elongation, fifty-three degrees, about the 10th of November. From this time it began to fall back with respect to the sun, and continued to approach it with an accelerated motion, till it was at length lost in the twilight.'

The general appearance of the comet, the remarkable form and length of the tail, as described by Professor Farrar, are such as every one will recollect. The account is accompanied with a drawing not very well executed. It

represents the head of the comet surrounded with a dark space of considerable extent, and exteriour to this a luminous arch resembling a halo. This zone of light after passing about half way round the comet, moves on in a rectilinear course, forming the two branches of the tail. The whole appearance was such as would arise from light reflected from particles of the comet's atmosphere, driven off by the impulse of the solar rays, the stronger light of the envelope, and two branches of the tail being supposed to proceed from the greater depth of illuminated atmosphere in those directions. A hollow luminous cylinder terminated by a luminous hemispherical cap would evidently present the strongest light toward the edges and the weakest in the middle, with a gradual variation of intensity through the intermediate space. This hypothesis is rendered the more probable from the very great extent and opacity of a comet's atmosphere, compared with the atmospheres of the planets, as also from the circumstance of the smallness of the attractive force exerted by the comet to confine this fluid. The diameter of the solid body of this comet, according to Dr. Herschel, was only 428 miles, while that of the atmosphere was 507,000. The diameter of the comet of 1807 was 538 miles, that of the atmosphere 188,680.

The observations for determining the elements of the orbit of this comet, consist of the distances of several of the most remarkable fixed stars in its neighbourhood, taken with a common sextant. We are happy to learn, that the College is about to be provided with the means of making astronomical observations with more facility and accuracy, that the Corporation have it in contemplation to erect a respectable observatory, and to furnish it with the best instruments. We are persuaded that such an establishment would add very much to the reputation of our beloved university, and contribute something toward raising the scientifick character of our country.

No. XLII. *Elements of the orbit of the Comet of* 1811. By Nathaniel Bowditch.

This paper contains the geocentrick longitudes and latitudes of the Comet in fifty-seven observations, made at Cambridge, Nantucket and Salem, from September 6, 1811, to December 20, 1811, with an abstract of the calculation

of the elements of its orbit, computed by combining all these observations. These elements are as follows:—

Perihelion distance, 1,035131, the mean distance of the earth from the sun being unity.
Time of passing the Perihelion, September 12d, 4h. 0' 48" mean time at Greenwich.
Longitude of the Perihelion, counted on the orbit of the Comet 75° 7' 49".
Longitude of the Ascending Node, - - - 140° 25' 46".
Inclination of the orbit to the Ecliptick, - - - 73° 5' 11".
Motion *retrograde*.

The geocentrick longitudes and latitudes being computed by these elements, and compared with the observations, and the difference or errours being found, they satisfy the following conditions:—The *sum* of the errours in longitude and latitude for *all* the observations, *noticing the signs is nothing*, and the same takes place by separating the observations into two nearly equal portions, including in one portion the observations from September 6, to October 17, and in the other, those from October 18, to December 20. These conditions being satisfied, the *sum* of all the errours in longitude and latitude *neglecting their signs is a minimum*, or less than it would be if any of the elements were varied from the above values, still satisfying the first mentioned conditions. These elements were afterwards found to agree very nearly with those published by European Astronomers.

No. XLIII. *Estimate of the height of the White Hills in New-Hampshire, By Nathaniel Bowditch.*

The White Hills are the highest mountains in New-England. They have been estimated, by Dr. Belknap, in his history of New-Hampshire, to be more than 10,000 feet above the level of the sea: but by the barometrical observations of Dr. Cutler and Professor Peck, computed in this paper, this estimate appears to be too great. The result of the calculations made from these observations is, that their height is not far from 7,000 feet above the level of the sea.

No. XLIV. *Method of displaying at one view all the annual cycles of the equation of time, in a complete revolution of the sun's apogee. By James Dean, A. M. A. A. S. Professor.*

This is done by means of a figure engraved on one of the plates with a moveable card attached to it, by which the equation of time, arising from the obliquity of the ecliptick, and the inequalities of the motion of the earth in its orbit, is shewn in a simple manner, by inspection, for any situation of the sun's apogee. We shall not attempt to give a description of this method, as it would require a reference to the figure.

No. XLV, is a letter from the Reverend T. Alden, giving an account of the effect of the electrick fluid, on a lady, in a house struck by lightning, in New-Jersey. The fluid entered at the elbow, passed up the arm, down the body, into the foot, from whence it escaped into the floor, tore up some of the boards, and went off in different directions. The principal object of the letter, however, is to mention the utility of galvanism, to remove the effects of similar shocks. Galvanism was applied in fifteen minutes from the time of her having received the shock, and though the torpor occasioned by it remained for two or three days, she was in a week perfectly recovered.

No. XLVI, is a communication from J. Tilden, Esq. relating to a very curious phenomenon, in the manner that lamprey eels are affected by human saliva. The experiment, quite familiar to the people of the country, was tried near the falls of Machias, where these fish adhere to the rocks so tenaciously, that it is difficult to remove them by a blow with a stone or a stick: 'but on spitting into the 'water they instantly spring out of it in the greatest agita-'tion.' They appeared to be in great pain, and when they fell back into the water, did not resume their places, but floated down with the current. A small stone wet with saliva, and thrown into a large body of water will produce the same extraordinary effect on these fish. If all facts which are difficult to be accounted for, should be considered incredible, this would certainly be one of the number. We know that the human tongue can distil gall and bitterness, that it can dry up the sources of happiness, curdle the blood more speedily than the bite of the Cobra di Capello, and extinguish life itself in agony: but, these effects

we thought were confined to its influence on our own species. That the unfortunate *Petromyzon marinus* should be so affected by what passes from it, is indeed wonderful; and the way in which it acts upon them certainly merits investigation.

We might, perhaps, without presumption, reproach the society, with having suffered such a curious fact to remain so long in their possession unheeded. Mr. Tilden's letter is dated in November, 1809. We think if the members were divided into different classes or committees, having separate branches confided to their particular care, that they would proceed with more energy and effect. If such an arrangement were made, so curious a fact as this communicated by Mr. Tilden would not have remained, six years, without further inquiry.

No. XLVII. *On the variation of the magnetical needle, by Nathaniel Bowditch.*

The object of this paper is to prove that the variation of the magnetical needle in this part of the country, continues to *decrease*, in the same manner as it has done since the times of the earliest observations; which is contrary to the opinion of some of our surveyors, who have supposed that a sudden and very unexpected change has been observed in it, particularly in New-York, between the years 1804 and 1807, where the variation was supposed by some persons to have increased as much as 45 minutes, but in general they have not taken notice of the *diurnal variation*, which sometimes exceeds even that quantity. For, by the observations made at Cambridge by Professor Sewall, in 1782, the variations changed from 6° 21′ to 7° 8′ in two months, and Mr. Bowditch noticed a change of 48′ in the years 1811, 1812, at Salem. A greater difference than this will sometimes be found by using different instruments, as appears by the observations in this paper made in April, 1810. Indeed a much greater difference than this was observed by the celebrated Cook in one of his voyages around the world, in some observations made on shore, with several azimuth compasses constructed with great care and expense for his use on that voyage.

Mr. Bowditch observed the variation at Salem at different hours of the day, from April, 1810, to May, 1811, and

by the mean of more than five thousand observations it was found to be 6° 22′ 35″ west. Twenty-nine years before that time it had been observed, in nearly the same place, by the late venerable President Willard, and found to be 7° 2′ W. By making an allowance of 2′ for the difference of the situations, it appears that the annual decrease is 1′ 19″, which is at nearly the usual rate observed many years ago. For, in 1708, the variation was 9° W. which, compared with the observations of President Willard, give nearly the same annual decrease.

We have extracted from this article the following table of the variation for each hour of the day, deduced from the mean of the observations at Salem just mentioned. It appears from this table, that the variation at 6 H. A. M. was 6° 19′ 1″, it increased gradually till 2 P. M. when it was at its *maximum* 6° 27′ 9″, it then decreased till 10 H. P. M. when it was 6° 20′ 38″

Hour	Mean Variation in 1810, 1811.
A. M.	West
6	6° 19′ 1″
7	6 19 7
8	6 19 9
9	6 20 28
10	6 21 15
11	6 22 46
12	6 24 7
P. M.	
1	6 25 47
2	6 27 9
3	6 27 0
4	6 25 57
5	6 24 26
6	6 23 19
7	6 21 55
8	6 21 11
9	6 20 54
10	6 20 38

No. XLVIII. *Description of a Cometarium, by James Dean, A.M. &c.*

This instrument is designed for a similar use to that of the Cometarium explained by Ferguson in his Astronomy, but it is superiour, because it is capable of representing any degree of eccentricity, and being made with toothed-wheels, it is much less liable to errour than the banded instrument of Ferguson. We cannot easily describe this instrument without a scheme to refer to.

No. XLIX, is an account of an earthquake, by the Hon. S. Tenney, that happened in November, 1810, and was most strongly felt in New-Hampshire. It furnishes another document for the history of earthquakes in this country. The noise of the reports, in the present instance, announced a more violent concussion, than the one which actually took place. The trembling motion lasted about a minute. The author describes it a little in the style of an amateur, as producing a most 'beautiful vibration of the floor.' There is no affectation in this; the earthquakes, though they have been numerous in the eastern states, have never yet occasioned much mischief, the horrour, therefore, which is felt at the slightest shock, by the inhabitants of those countries which have been ravaged by them, is fortunately unknown here, though it may, perhaps, be apprehended from the shocks we have already received, that they may be more serious at a future period.

No. L, is a communication on the same subject from governour Sargent, giving a minute detail of the repeated shocks that took place on some parts of the River Mississipi, at the close of 1811, and 1812. These were of great violence and did much damage, they were also felt to a great distance, though their greatest ravages were between the Natchez and the Chickasaw Bluffs. Governour Sargent's paper is accompanied with a meteorological diary, and is a valuable document.

No. LI. In this memoir we have an abstract of meteorological observations taken at Cambridge from 1790 to 1813, with abridged tables and results, giving a more complete view of the state of the Barometer, Thermometer, winds and weather, than is to be found respecting any other place in this country. These tables make known to us several of the anomalies of our climate. The Barometer, it seems, has a tendency to stand higher in the morning and evening than at

mid-day, and higher about the time of the equinones than at the solstices; and the fluctuations are greater in winter than in summer. From a table, intended to test the influence of the wind on the Barometer, it appears that the greatest and least elevations often occur with the wind in the same quarter, but the greatest elevation takes place almost invariably in fair weather, and generally with the wind between the points of west and north, and the least elevation during foul weather and rain. The annual range of the Barometer is about two inches; that is, the variation of atmospherick pressure, is about one fifteenth of the whole quantity.

The temperature of our atmosphere, according to the view here presented, has peculiarities still more striking. The annual variation of the Thermometer, frequently exceeds an hundred degrees, whereas in the corresponding latitudes of Europe, it seldom amounts to two thirds of this quantity. The monthly and daily variations also are very remarkable; and it is worthy of notice, that while the former is greatest in winter and least in summer, the reverse is true with respect to the latter. The ordinary variation of the Thermometer, during the day in winter, is about eight degrees, in summer it is not less than twelve or thirteen degrees. The monthly variation, at a mean, is about fifty degrees in January, and about thirty-four in July.

With regard to the hygrometrical character of our climate, it is a singular fact that we have more fair weather and a drier atmosphere, at the same time, that we have more rain, than is known in almost any part of Europe. We have ordinarily about two hundred fair days in the course of the year, a little more than one hundred cloudy without rain, and about sixty during which there is a fall of rain or snow. The number of rainy days alone is about forty-four. The proportion of fair weather in the summer months is about one third greater than in the winter months.

Our prevailing winds are from the west and north-west. In the winter season the wind blows from this quarter more than half the time, and from the north-west only one third of the time. Thence the excessive cold of our climate. The influence of the wind upon the temperature of the air is clearly shown in the last of this collection of meteorological tables. It exhibits the means of a number of observations, taken for fair weather and foul, for morning, noon, and night, during the winter and summer months; and so selected

and detached from all other circumstances, affecting the Thermometer, as to exhibit as fairly as could well be done, the simple effect of the *direction* of the wind. From this table it appears, that, during the winter in fair weather, the wind from the north-west is about sixteen degrees colder than the wind from the east and south-east. In summer the warmest wind is from the south-west and the coldest from the north-east and east. The difference of temperature, at a mean, is about ten or twelve degrees.

LII. On the motion of a Pendulum, suspended from two Points. By Nathaniel Bowditch, A.A.S. &c.

In this paper is given the theory of the curves described by a pendulum suspended from *two* points. Professor Dean first started this subject in his investigation of the motion of the earth, as viewed from the moon, in article 34th of this volume, in which he has shewn how the great variety of curves described by the earth in the motion treated of by him, could be imitated by such a pendulum. Mr. Bowditch has taken up the subject in a general manner, and shewn, that there is an endless variety in the curves described, depending on the proportions which the different parts of the pendulum bear to each other.

To give an idea of these motions, we shall describe the manner in which one of the experiments, mentioned in this work, may be repeated, and we shall modify the method a little, on account of not having a figure to refer to.

A line 4 3-4 inches in length being measured on a horizontal plane, and in the direction of the meridian, its middle point is called the *centre of the pendulum*, and its extremities the *points of suspension*. To these points must be attached the ends of a small flexible thread nearly five inches in length, and the middle point of this thread is called the *centre of the thread*. To this last centre, as a point of suspension, must be attached a pendulum of the common form, composed of a thread 46 1-2 inches in length, and a smooth leaden ball, of half an inch diameter or more. This constitutes one of the pendulums spoken of in this paper. When it remains at rest, supported by its *two* points of suspension, the respective *centres* of the pendulum thread and ball will evidently be in the same vertical line, and in this experiment the distance from the *centre* of the pendulum to the *centre* of the thread is about 2-3 of an inch. If a small velocity be now given to the ball in the direction of

the plane of the meridian, it will vibrate backwards and forwards about the centre of the thread, like a common pendulum suspended from that centre, and the same will take place if the projection be made in the direction of the prime vertical, (or in an east or west direction,) only the vibrations will now be made about the centre of the pendulum, instead of the centre of the thread; and there is nothing particular in either of these motions. But this will not be the case if the ball is projected in an oblique direction, as for example, in a south-west direction, for then the pendulum will at first vibrate backwards and forwards in the direction of the line of projection, then its path will gradually expand into an elliptical form, and at the end of about seventy vibrations, it will be nearly *arcular*, and the motion will be in the direction of *the sun's diurnal motion;* after a few more vibrations the curve will become *elliptical*, and the ellipticity will gradually decrease; till at the end of seventy more vibrations the curve will become nearly a *right line* in a direction *at right angles to the former right line*, that is, in the direction of the north-west and south east. After vibrating a few times in this way, it will again become *elliptical*, and, at the end of seventy more vibrations, it will be again of a circular form, but the motion will be in an *opposite direction* to what it was before; for it will now be *contrary to the sun's diurnal motion.* In a few more vibrations the curve will again be elliptical, and at the end of two hundred and eighty vibrations from the commencement of the motion, it will fall into the same right line in which the pendulum was first projected, the cycle of motions will then be completed, and the pendulum will recommence the description of the former curves.

In this experiment, the distance of the ball from the centre of the thread is much greater than the distance from the centre of the thread to the centre of the pendulum, the ratio of these quantities being as 2-3 : 46 1-2, or nearly 70 : 1. It is proved in this paper, that four times the ratio of these two distances will nearly express the number of vibrations necessary to complete the cycle of motions, so that by varying the ratio of these lines, we may form a pendulum, whose motions will be completed in any proposed number of vibrations. Every variation, in this ratio, will produce changes in the forms of the curves, and in the times of vibration; but it is remarkable that the distance of the two

points of suspension from each other may be varied at pleasure, without affecting either the forms of the curves or the times of vibration; the arcs of vibration being always supposed to be sufficiently small to keep the pendulum always supported upon those *two* points, and never upon *one* only.

When the centre of the thread is nearly three times as far from the centre of the pendulum as from the centre of the ball, the pendulum will, for a short time, vibrate backwards and forwards in a parabolick arch, (like a semi-ellipsis,) this will gradually change into a curve of two branches, which will finally form a figure like the numerical character 8; after a few more vibrations, the pendulum will describe another similar parabolick arc, but in an inverted position and direction, and then will recommence the description in a retrograde order, of the curves already passed over, till it falls into the curve first described, and then the cycle of motions will recommence in the same order as at first.

We shall not notice any more of these curves, and shall close our account of this article by observing, that a *general* method of computing the times of vibration in these curves, as well as their form, is given, and the whole calculation is made by the algebraical, or rather fluxionary calculus with occasional references to geometrical figures.

No. LIV, *is a memoir on the present state of the English language in the United States of America, with a vocabulary, containing various words and phrases which have been supposed to be peculiar to this country. By John Pickering, A. A. S.*

It is not our intention to enter now into an examination of this valuable paper, which occupies nearly one hundred pages, because we have been informed that Mr. Pickering intends to publish it again in a separate volume, with additions. Dr. Franklin, Dr. Witherspoon, and others of less note, have written on this subject; but all that has hitherto appeared, are only hints, or desultory essays, in comparison with this memoir, from which, we trust, the Academy will derive honour, the author credit, and the publick improvement.

The subject is very interesting, and, perhaps, more important than many are in the habit of considering it. Literary men should preserve the purity of a language, with the utmost zeal and caution; it is the sacred fire of Vesta,

whose extinction would be ominous if not fatal to the republick of letters. In spite of those egregious writers and speakers, who think, that to alter our language will promote our patriotism, we hope that a sound respect for the great standard authors of the language will so far prevail, that innovation and false taste will be rigidly proscribed. Indeed, if this should not be done, we should despair of the destiny of our country, for we believe that, without any exception to the contrary, the corruption, decay and loss of every language has always accompanied the decline and fall of every nation with whom it originated. Our relative condition, in this respect, might furnish some curious philosophical speculations, which we have not now room to pursue to their full extent. If the Roman empire, in the time of Augustus, or even the Antonines, had been able to colonize an extensive continent, and had planted with those colonies the seeds of learning from the metropolis, could such a colony have survived the degradation of the empire? would the orations of Cicero, and the odes of Horace, have found admirers, and imitators in that colony after the decline of the parent state; or would they have accompanied the course of the latter, till all learning should have dwindled into the obscure quibbles of sectarian theology, and Greek sophistry, expressed in a barbarous phraseology, well suited to these subjects? It is asserted by some naturalists, that a tree cannot be prolonged by ingrafting its shoots, beyond a certain period, and that when the original stock dies, the scions, however vigorous may be the tree, to which they are transferred, will also perish. It may be hoped that there will be no analogy to this fact, in the fate of nations: we might otherwise anticipate a premature decrepitude, since our parent state has already passed her Augustan age, and, unless the course of experience is to be falsified in her favour, and the seemingly inevitable tendency of human institutions to be averted; she must deteriorate and perish, like the illustrious nations of antiquity, whom she has rivalled. If, however, by being transplanted here, into a virgin soil, our constitution has been renovated, and we are now starting in a youthful career, to proceed through a natural progress to maturity, and far removed old age, it will be a new example in the history of the world; the first instance in which any nation will have had the privilege of going through a second edition, if the stale

figure will be tolerated, enlarged, if not improved. It may be asserted without extravagance, that one of the surest indications of our being destined to give this fortunate example, will be our preserving, the energy and beauty of the language in all its original purity. We may, perhaps, now presume that our imperfections are owing to the want of care and cultivation, and not to the exhaustion of a worn out soil. The manifest tendency, and evident progress towards deterioration in the language in England, produced by a variety of causes, easily discerned, should put us more on our guard, and make us more rigid in referring all decisions on the language of our own writers, to the standard of the great classick authors of England. Vicious idioms, and that jargon of language, which are invading their literature in every direction, have not yet reached the highest class of productions, though the inferiour ones are almost overrun with them. Historical and philosophical, as well as most works in belles lettres are still pure, but the periodical productions, particularly of the newspaper class, the novels and romances, much of the poetry and the drama, and generally all the lighter kinds of books, are deeply and incurably infected. We are exposed to the same infection from most of its sources, but generally in a less degree, and from some we are almost wholly exempt. Still we have many things to guard against, and much correction and study to endure before we arrive at those noble heights of literature, that we may eventually reach, and where we may, in turn, erect monuments that shall be admired by the civilized world, in the same range with those of the classick authors of ancient and modern learning.

We perfectly agree with Mr. Pickering, that we should pay particular attention to the remarks of English criticks on our productions, and carefully note all the innovations which they may point out, and where these are useless and awkward, as in almost every instance they will be, we should denounce them without mercy. This recommendation is more necessary, because it is difficult to avoid irritation, at the indecent and unfair remarks of many of the English journalists, with some of whom it has become a habit, on other subjects as well as language, to pollute their pens when any thing American is before them, with scurrility and misrepresentation. Even the monstrous perversions and fancies of Mr. Barlow, which it would puzzle

the grammarian as much to class, as it would the naturalist to arrange the Sphynxes and Centaurs under the system of Linnæus; even these, obviously individual absurdities, were put down against the nation at large, by the Edinburgh Review, from whose general character we expect manly and honourable treatment.

With the greatest deference to their ancestors, we are not disposed blindly to submit to the writers of the present day in England, not only, because we cannot always expect justice from our contemporaries, but for another reason also, that they have degenerated themselves from their own models. We contend that we have the same privilege that they have, and sometimes more reason for introducing new terms; at the same time we would only use this privilege with the utmost caution, and should hold the practice on all common occasions, more honoured in the breach than in the observance. To some of the words they have introduced, we should cheerfully give the freedom of the republick of letters—*accede* for instance, now a common and convenient word, was fifty years ago considered pedantick—see also *inimical*, and others in Walker. There are some of our words that we must contend for in turn, and maintain their rights because they are eminently useful, and grew, not out of individual caprice, but the peculiarities of our situation. Such are the words, *locate*, *girdle*, and two or three others. We think too that we could not well spare *influential*, and *subscriber*; but *lengthy* we can never give up. We have a particular affection for it, and in spite of its cisatlantick origin, it will obtain a footing in England, where they have as great or greater need of it. We feel grateful to a word that has so often given vent to our feelings. At least with us it associates, *long*, *tedious*, *awkward*, and half a dozen others, that it would be extremely inconvenient to call into use every time we have occasion for them.

We shall look forward with eagerness to a separate edition of Mr. Pickering's work; no man is better qualified for the undertaking, by his various knowledge, his travelled experience, and habitual accuracy and depth of research. To those who know how slow and difficult it is to mature a work of this kind, the present memoir will afford a sufficient proof of the ability and labour of the author.